Managing Cultural Variation in Software Process Improvement

A Comparison of Methods for Subculture Assessment

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Abstract

The scale and complexity of change in software process improvement (SPI) are considerable and managerial attention to organizational culture during SPI can therefore potentially contribute to successful outcomes. However, we know little about the impact of variations in organizational subculture on SPI initiatives. On this backdrop, we report from a large scale SPI project in a Danish high-tech company, *Terma*. Two of its business units – Integrated Systems (ISY) and Airborne Systems (ASY) – followed similar approaches over a two year period, but with quite different outcomes. While ISY reached CMMI level 2 as planned, ASY struggled to implement even modest improvements. To explain these differences, we analyzed the underlying organizational culture within ISY and ASY using two different methods for subculture assessment. The study demonstrates how variations in culture across software organizations can have important implications for SPI outcomes. Furthermore, it provides insights into how software managers can practically assess subcultures to inform decisions about and help prepare plans for SPI initiatives.

Keywords: Organizational culture, Organizational change, Process improvement., Corporate Culture, Improving the organization

1. Introduction

Software Process Improvement (SPI) has been practiced for many years and is now widely adopted in the industry. To paraphrase Kautz, SPI is a field of research and practice that focuses on managerial and process oriented aspects of software development [29]. Hansen et al. have expressed it aptly by stating that SPI ”deals with the professional management of software firms, and the improvement of their practice, displaying a managerial focus rather than dealing directly with the techniques that are used to write software” [22, p. 457]. There are many different models available for SPI (e.g. [50], [34], [57]), but the Capability Maturity Model Integration (CMMI) is one of the most widely adopted frameworks for evaluating, benchmarking, and improving software processes based on what numerous companies consider best practice [12]. Consequently, CMMI has in many ways become a de facto standard for SPI [14]. SPI researchers have focused on a wide variety of problems and challenges confronting organizations engaging in SPI [1], [22]. While there is general agreement that SPI is associated with considerable organizational changes both in terms of scale and complexity [40], organizational issues have been inadequately prioritized in the SPI literature and our current knowledge is therefore insufficient [47], [41].

Insight into organizational culture can be particularly helpful for managing complex change processes (e.g. [48], [10]). However, our knowledge about the role of culture in relation to SPI is limited. While existing research indicates that culture is a factor to be reckoned with in software organizations (e.g. [16], [17], [67], [46]), no research within the SPI literature explicitly investigates the role of subcultures on SPI initiatives. On this backdrop, the present study seeks to expand our knowledge about the role of culture in SPI by addressing two research questions: (1) How can variations in culture explain differences in outcome of improvement initiatives across a software organization? (2) How can software managers assess subcultures within their organization to inform SPI initiatives?

To that end, we have conducted an in-depth, collaborative case study [68], [39] of SPI in a Danish high-tech company, *Terma*, over a two year period. Two of its business units – Integrated Systems (ISY) and Airborne Systems (ASY) – followed similar approaches, but SPI outcomes in the two units were quite different. While ISY reached CMMI level 2 as planned, ASY struggled to implement even modest improvements. Subsequently, we used two different methods [11], [58] to understand similarities and differences in subculture between ISY and ASY and to explain the identified variations in SPI outcomes. The research contributes to the literature on SPI by demonstrating how variations in culture across units in a software organization may influence SPI outcomes. Also, a comparison of the two assessment methods leads to suggestions for how software managers can practically assess subcultures to inform decisions about and help prepare plans for SPI initiatives.

The argument is structured as follows. Section two gives a detailed account of what we know about culture in relation to SPI and management of software organizations; the section concludes by motivating our research objective and questions. Section three reviews the role of organizational culture in managing change, and it presents the two perspectives on culture adopted in this study [11], [58] together with the related assessment methods. Section four presents the case context at *Terma*, our overall research design, as well as a detailed description of how the two assessment methods were used to understand cultural similarities and differences between the ISY and ASY business units. Section five provides documentation of the SPI initiative and the different outcomes within ISY and ASY, and section six presents the results of the assessments of subcultures in the two business units. Subsequently, in section seven we discuss the key findings in relation to our existing knowledge on managing SPI initiatives as well as limitations and implications for both theory and practice. Finally, section eight concludes the argument.

2. Culture in SPI

While culture is an important object of study within management of information technology (IT), Ford et al. argue that most research has focused on IT management in general whereas other issues, e.g. software development, have largely been neglected [19]. As examples of the documented interest in cultural analyses of IT management, Png et al. have studied adoption of IT infrastructure and demonstrated the importance of national culture as a conditioning factor [53]. Tan et al. has compared the predisposition of people to report bad news in software projects and documented the moderating effect of national culture on organizational climate (whether reporting bad news results in reward or punishment) and information asymmetry (whether hiding bad news is feasible over time) [62]. At the level of communities of practice, Meier has drawn attention to the need for management to take occupational cultures into account when planning technological innovation; conflicts may otherwise arise due to different mental models or cognitive representations of technology [43]. At the level of organizational cultures and subcultures, Huang et al. have shed light

on how cultural variations during implementation of company-wide information systems may challenge knowledge sharing and collaboration among groups [25]. Studies like these demonstrate the importance of understanding and addressing cultural issues related to management of IT in general.

Leidner et al.'s recent review of the literature on the role of culture in management of IT led, however, only to identification of three studies on the influence of organizational culture on SPI [35]. Two of these studies focused on implementation of new software processes into established management practices. The first concluded that "a good fit between the values embedded in a development process and the values that are part of the organizational culture will lead to a successful and appropriate solution and, more importantly, an easier one to implement" [16, p. 57]. The second study confirmed this finding and underscored "the importance of understanding the cultural foundation of management practices used in software development. These practices evoke interpretations from members of a culture, who collectively redefine what might have been intended" [17, p. 224]. The third study focused on the values underpinning models for SPI and suggested that the cultural assumptions embedded in the CMM models may be at odds with the culture of the adopting organization thereby impeding or even preventing process improvements from being implemented [46].

To identify additional articles on culture in SPI, we searched the journals on the Association of Information Systems' journal ranking list (http://www.isworld.org/csaunders/rankings.htm) that were not included in Leidner et al.'s review [35]. This led to identification of four additional studies. First, Yamamura has stressed the need for process improvement and employee satisfaction to go hand in hand. Managers are advised to actively promote a work climate, or organizational culture, in which highly satisfied and motivated employees thrive, e.g. by way of forward planning, disciplined development environments, growth opportunities, special assignments, and mentoring. Such initiatives may facilitate SPI because "people that are well trained, fit the job, have the right skills, are motivated, and execute their tasks with passion are the most likely to help a project succeed" [67, p. 85]. Second, Boehm has described social shortcomings of the SW-CMM, e.g. that it reinforces the sequential waterfall process that encourages "separation of concerns." Subsequently, he has highlighted features of the CMMI that overcome this problem through unification of software and systems engineering. The underlying challenge for management is, however, that the use of these two models fosters different types of cultures [8]. Third, Frederiksen et al. have demonstrated that software development practices are socially constructed and have a tendency to reproduce cultures which may present obstacles for SPI [20]. Fourth, Phongpaibul et al. have found that to successfully improve software processes in Thailand, researchers and practitioners must appreciate the cultural context and tailor western style processes to Thai software development practices [52].

There is, in summary, considerable research that demonstrates the importance in general of understanding and addressing cultural issues in management of IT; but the specific insights into the role of culture in SPI is still limited. We do know, however, that it is important for managers to consider the fit between values embedded in new processes and the context in which they are to be implemented [16], [17], [67], [20]; to appreciate the values underpinning maturity models and models for software development [8], [46]; and, to take differences in values into account when western style SPI models are adopted in nations with quite different cultures [52]. Despite these contributions to our knowledge about culture in SPI, current research has not addressed how variations in culture across software organizations may impact SPI outcomes. Neither has current

research provided us with insights into how software managers can practically assess subcultures to inform decisions about and help prepare plans for SPI initiatives. The study reported in this article was designed to fill these gaps.

3. Cultural Perspectives

3.1 Organizational Culture and Subculture

Organizational culture is an ambiguous concept that has been defined and interpreted in countless ways [36]. Leidner et al. point to the challenge of "arriving at an understanding of what culture is, given the myriad of definitions, conceptualizations, and dimensions used to describe this concept" [35, p. 359]. Although the concept has been attributed to Pettigrew [51], writings on organizational culture have deep roots in cultural anthropology [31]. In this article, we adopt the predominant theoretical approach to organizational culture, the so-called values based approach [35], [61]. Within this approach, Schein defines culture as "a pattern of shared basic assumptions that was learned by a group as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" [58, p. 17].

Shared values, norms, and ideas play an important role in determining the areas in which an organization is able to learn and those situations in which it is likely to resist change [3]. Where an event in the environment is consistent with the organization's cultural values, the organization will more likely respond constructively than if the event contradicts its values [3]. Not surprisingly, previous research has demonstrated in detail how organizational culture has impacted the outcome of specific types of change initiatives, e.g., TQM [6], [15], [9], [33], BPR [28], [49], and ERP [32]. As a consequence, managers are advised to assess organizational culture to inform how to effectively organize change initiatives [27], [23].

In this paper, we investigate variations in subculture across two business units and how this can explain differences in SPI outcomes. Numerous studies document the existence of organizational subcultures and countercultures in different types of organizations (e.g. [63], [56], [69], [5]). Van Maanen et al. define an organizational subculture as "a subset of the organization's members who interact regularly with one another, identify themselves as a distinct group within the organization, share a set of problems commonly defined to be the problems of all, and routinely take action on the basis of collective understandings unique to the group" [64, p. 38].[1] Hence, frequent interaction, a sense of belonging, and shared problems are key factors in understanding why and where organizational subcultures emerge.[2] Subcultures therefore develop over time as subgroup members interact and face new problems together. According to Schein there is nothing to suggest that organizational culture and subculture are qualitatively different. Instead, they merely constitute different levels of analysis and they can be studied and assessed using the same methods [58]. A

1 Note that this definition concerns the boundaries – not the content – of an organizational culture. As regards the content, Van Maanen et al. describe culture as "a set of solutions devised by a group of people to meet specific problems posed by the situations they face in common" [64, p. 33]. In a similar vein Jermier et al. have defined the concept of an organizational subculture as "shared understandings about the organization's mission and standards of conduct, as well as the corresponding organized practices that emerge in a group of employees" [26, p. 172].

2 Organizational subcultures may also be influenced by technological innovations, competing ideologies, marginalization, pressures of socialization, external turbulence, personal attributes (age, gender, and race), socio-cultural backgrounds (family ties, education, and social class), and working conditions (role, occupational specialty, departmentalism, and work shift) [18], [64], [42], [26], [30].

plethora of methods have been developed to assess organizational cultures [4]. In this study, we have used two methods – one quantitative the other qualitative – to investigate cultural variations across ISY and ASY within *Terma*. The two methods are quite different in content and form. The quantitative tool is based on the competing values framework [11] originally developed by Quinn et al. [54] and the qualitative on the clinical inquiry framework by Schein [58]. Both the competing values framework and Schein's culture model have been used successfully in a number of different contexts [60], [45], [13], [2].

3.2 The Competing Values Framework

The competing values framework (see Figure 1) identifies four clusters of opposite – or as the name suggests competing – basic assumptions, orientations, and core values that underlie organizational culture [11]. Different indicators of organizational culture are understood along two dimensions. One dimension differentiates stability, order, and control from flexibility, discretion, and dynamism. The other dimension contrasts internal orientation, integration, and unity with external orientation, differentiation, and rivalry. The resulting quadrants represent four culture types labeled clan, adhocracy, market, and hierarchy respectively. These types are theoretical constructs or archetypes, and most organizations contain elements of all of them [11]. The assessment method establishes a culture profile based on these four culture types. That is, the method assesses the relative importance of the four types in an organization. For example, an organization might be dominated by the clan culture type (60%), supported by elements of the adhocracy culture type (30%), but only marginally influenced by the hierarchy and market culture types (5% each).[3] The competing values method is quantitative and uses a survey instrument to assess organizational culture. Figure 1 illustrates the two-dimensional space that embraces the four culture types. The figure also contains keywords that are used to describe each of these culture types.[4]

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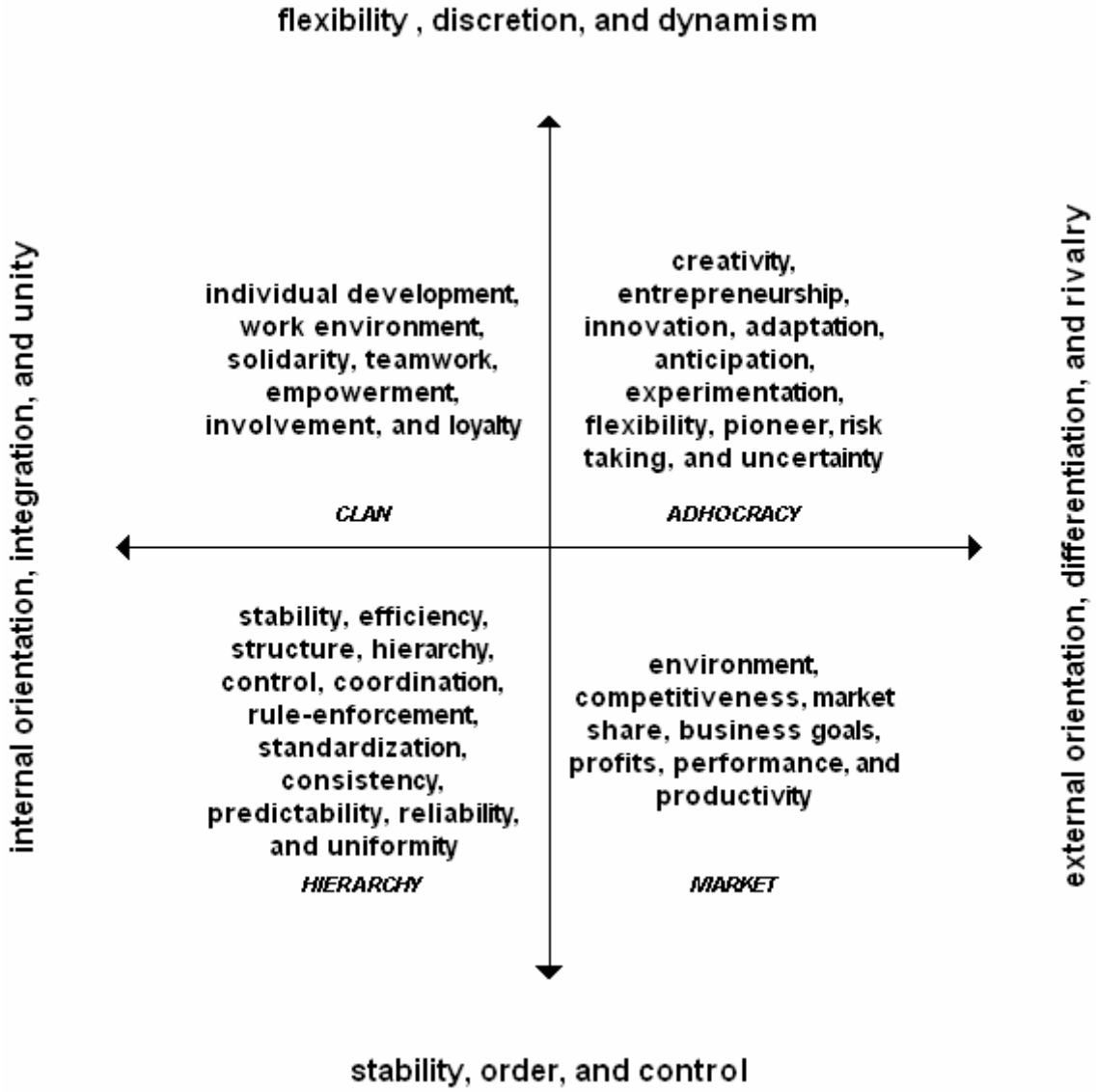
3 However, there seems to be an inherent danger in attaching too much importance to the numerical values ascribed to each of the culture types, e.g. by claiming that the organization is x % hierarchical, y % market oriented, z % clan, and w % adhocracy. Therefore, the percentage points should be interpreted as expressions of tendencies within the organization rather than facts [11].

4 In a clan culture commitment to employees and their individual development takes center stage. Emphasis is on the work environment, solidarity (internal cohesion) and teamwork, and other keywords that describe this culture type are empowerment, involvement and loyalty. In an adhocracy culture creativity, entrepreneurship, and innovation take center stage. Emphasis is on adaptation, anticipation, experimentation, and flexibility in order to seize new opportunities, to be a pioneer, and to stay at the cutting edge in what is sometimes a rapidly changing environment. Other keywords that describe this culture type are risk taking and uncertainty. In a market culture customers and the external environment take center stage. Emphasis is on competitiveness, market share/penetration, business goals/targets, and profits. It is a results-oriented organization, and other keywords that describe this culture type are performance and productivity. In a hierarchy culture stability and efficiency take center stage. Emphasis is on structure/hierarchy, control, and coordination through rule-enforcement and standardization (formal policies, procedures, and rules). Other keywords that describe this culture type are consistency, predictability, reliability, and uniformity.

Figure 1: The Competing Values Framework



Source: Adapted from Cameron et al. [11].

There are at least three advantages to using this method. First, it is a non-intrusive and inexpensive[5] way of assessing an organization's culture profile. Second, the method has been substantially validated [13], [2]. The authors cite empirical validation in numerous organizations where the method has been used by both practitioners and researchers [11]. Third, the underlying framework has been used to analyze the values underpinning the CMM models [46].

3.3 The Clinical Inquiry Framework

The clinical inquiry framework is a qualitative approach to assess organizational culture based on workshops [58]. The notion of "clinical" was introduced by Schein [59] as a research approach based on his reputed conceptualization of organizational culture as having three levels: Artifacts at the surface level, values and norms at the intermediate level, and assumptions at the core level

5 Measured by the time used by each individual to answer the six questions on the questionnaire.

[58].[6] Group interviews, or workshops, are at the heart of this approach, because culture as shared assumptions makes it appropriate to gather data in a group setting to help participants elicit an understanding of their own culture. To ensure a common frame of reference, Schein's culture model is introduced as a first step to the workshop. Next, the participants are asked to describe their culture through artifacts and each cue is written down on flip charts. When new ideas stop emerging, the group is encouraged to express the values espoused or implied by the artifacts. Signs of either consensus or disagreement are important markers that signal possible conflicts between the articulated values and artifacts. Discrepancy may sometimes be reconciled by uncovering dominant yet tacit assumptions. Subsequently, the participants categorize the assumptions as either hindrances or aids in solving the problems at hand, i.e. "groups need to review what the 'new way of working' is and how the assumptions identified will help or hinder in getting there" [58, p. 346].

The workshops are facilitated by a process consultant to help participants explicate, in particular, shared tacit assumptions that lie at the core of their organizational culture. The role of the process consultant is to orchestrate the workshop and facilitate the group's own analysis of how the organizational culture affects problem solving or addressing the issue at hand. To the extent that the group members actively participate in the workshop, the process consultant remains quiet, but if guidance is needed it is the responsibility of the consultant to provide help in the form of raising questions or offering suggestions, e.g. pointing to decor, jargon, and dress code as potential categories of artifacts in order to motivate participants to speak their mind.

The advantage of using clinical inquiry analysis lies in the fact that it is based on Schein's reputed conceptualization of organizational culture. Moreover, it is a method that – in comparison to the previously mentioned survey approach to studying culture – allows us to appreciate the qualitative nuances of organizational cultures and subcultures.

4. Research Method

The research that is presented in this article is part of a collaborative practice study [39] that took place at *Terma* over a three year period from January 2005 to October 2007. Collaborative practice research studies work practices in an organization with the dual goal of improving these practices while at the same time making a contribution to research. In essence this approach combines action research with other research methods [39]. The basic approach is action research aiming "to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable framework" [55, p. 499]. Action research is then combined with practice studies (to understand current practices) and experiments (to design new methods and processes) and such activities are then reported as focused studies within the context of the larger action research effort [39]. This article presents the results of a practice study that was carried out as part of the larger effort at *Terma.*

4.1. Case Study Design

The reported research is based on an embedded case study [68]. The process was interpretive in nature [65] in the sense that our starting point was the meaning that the participants assigned to their experiences and the social context in which these experiences took place, i.e. we analyzed the

6 Assumptions are 'truths' that are taken for granted, exist on a subconscious level, and yet influence how organizational members perceive and interact with their surroundings. Values and norms are social guidelines that are fostered and supported by the aforementioned assumptions and affect judgments and behavior semiconsciously. Artifacts are tangible and conscious manifestations of a culture, e.g. buildings, rituals, and ceremonies [58].

participants' social construction of reality within ISY and ASY [7]. This approach allowed us to identify and understand the differences in behavior and mindset between groups of employees within the same company.

Case studies limit the prospect of generalization, i.e. it is important to be cautious when generalizing from our findings from *Terma* [21], [68]. Meanwhile, our selection of cases within *Terma* was based on replication logic to obtain comparable data. Hence, from the four business units participating in the corporate SPI project we chose two units for our investigation. These two units were very similar in terms of SPI implementation plans and were therefore initially expected to produce similar results (literal replication). However, as the improvement project unfolded the efforts within these business units developed quite differently. Assuming that differences in subculture could explain these differences, we combined literal replication with theoretical replication and chose two business units in which engineering and management practices were believed to be based on different values, norms, and ideas. This combination of literal and theoretical replication in the embedded case study design has added confidence and robustness to our findings [44], [68].

4.2. Data Collection and Analysis

Case studies allow for different data collection methods and multiple data sources to facilitate a deep understanding of the phenomenon being investigated and to increase the reliability of the findings [68], [38]. To ensure rich data from the two cases and to enable triangulation, we collected data from four different sources. First, we gathered written information including internal documents like organizational charts, SPI plans, and progress reports. Second, we collected audit and assessment reports from the process maturity evaluations that were performed during the SPI project at *Terma*. Third, we conducted a questionnaire based survey in the two business units with the aim of assessing the subculture based on the competing values framework [11]. Fourth, we conducted workshops in the two business units, with the aim of assessing the subculture based on the clinical inquiry framework [58]. The collection and analysis of these data is described next.

4.2.1. Process Improvement Analysis

Different forms of documentation were used to document the SPI process and its outcome within each of the two business units. The process of putting new work procedures into practice was tracked through business unit specific implementation plans, minutes of meetings, and progress reports. The outcome and development in process maturity during the implementation process was monitored through project level assessments performed internally at *Terma*, including business unit assessment reports as well as corporate audits that were conducted to verify the results of these unit level assessments.

4.2.2. Competing Values Analysis

Two surveys were conducted based on the Organizational Culture Assessment Tool (OCAI). The questionnaire that Cameron et al. present as the backbone of the OCAI was used [11]. The questionnaire was distributed electronically to employees in the two business units using the software tool Inquisite (http://www.inquisite.com). Inquisite was used to facilitate both data collection and the data analysis. By mid September 2006, the questionnaire was sent to 37 respondents in ISY and 40 respondents in ASY with respectively 85% and 55% of the respondents completing the questionnaire.

Since we were interested in the effect of organizational subcultures on process implementation, we found it appropriate to include only employees who had actually contributed to these efforts. Hence, instead of randomly selecting respondents, all middle managers, project managers, and project participants who had been affected by the SPI project through changes to policies and procedures were chosen.[7] Data were subsequently analyzed and culture profiles were established as described by Cameron et al. [11]. One profile was generated for each of the two business units. These profiles were then compared to take stock of any similarities and differences. Finally, the SPI plans of the two business units were compared against the established culture profiles to identify potentially conflicting approaches and goals.

4.2.3. Clinical Inquiry Analysis

Two clinical inquiry type workshops were held. The workshops were held in December 2006 with representatives from ASY and ISY separately under the guidance of two of the authors. 12 employees from ASY were invited to attend of which 9 participated in the workshop. 11 employees from ISY received an invitation and 10 attended the workshop. The participants were selected by the local SPI project manager in collaboration with managers who had experiences with implementing the new processes. From ISY the participants were 3 systems engineers, 1 systems designer, 3 project managers, 2 directors (”R&D” and ”Service”), and 1 vice president (”Projects”). These people had been employed for 4 to 21 years with an average of 10 years of employment. From ASY the participants were 1 software engineer, 1 systems engineer, 1 hardware systems analyst, 2 project managers, 1 manager (”Mission Support Systems & Ground Software”), 2 directors (”EWMS[8] Products” and ”ISR[9] & EW[10] Programs Overseas”), and 1 vice president (”RD&E”). These people had been employed from less than a year to 23 years with an average of 7 years of employment.

The two workshops were planned and carried out following the generic description of clinical inquiry [58, chapter 17]. Immediately following the workshops, the content of wall sheets was written down for later reference. In addition, audio recordings were transcribed, and for each of the key constructs (i.e. artifacts, espoused values, and basic underlying assumptions) all relevant statements and commentary were extracted for further analysis. The subsequent analysis was done in three steps. First, each of the two participating authors attempted to summarize the findings separately while staying true to the conclusions drawn by the workshop participants themselves. Second, research notes were compared to arrive at a common understanding and two culture profiles – one for ASY and one for ISY. Third, the SPI plans of the two business units were compared against the established culture profiles to identify potentially conflicting approaches and goals.

5. Process Improvement at Terma

In this section we describe the SPI initiative at *Terma* and in each of the business units. The purpose is to describe the context at *Terma* as well as the SPI initiatives and outcomes within ISY and ASY.

[7] Within each business unit a number of employees participated in the implementation of new processes, including project managers and project participants from selected projects, and SPI personnel that had been appointed to assist in the transition to new ways of working.
[8] Electronic Warfare Management System.
[9] Intelligence Surveillance & Reconnaissance.
[10] Electronic Warfare.

5.1. The Improvement Initiative

In 2005, *Terma* launched an SPI project that ran for two years. CMMI level 2 compliance was the goal and the project involved four of *Terma*'s business units. The SPI project had a process definition phase and a process implementation phase. During the definition phase, a number of teams were tasked with updating and supplementing existing policies and procedures as needed. To increase the likelihood of success of the subsequent implementation phase, it was decided to let the business units assume responsibility for local implementation. Each business unit was asked to submit an implementation plan detailing a roadmap for that particular unit. Two business units, ASY and ISY, submitted similar plans towards the implementation drawing on the generic process implementation plan that was offered to them by corporate services. Also, ASY and ISY selected a number of projects to take part in the implementation of the new processes based on similar selection criteria. However, in the end the two business units accomplished different results.

Table 1: Assessment results for ASY and ISY

Business unit	Assessment milestones		
	Milestone 1 (December 2005)	Milestone 2 (March 2006)	Milestone 3 (June 2006)
ASY	69.3	58.3	67.3
ISY	69.0	65.6	77.2

Process maturity assessments were performed three times during the implementation period corresponding to three implementation milestones that were specified in the business unit's implementation plans, see Table 1. It was determined that 75% compliance would satisfy the requirements of the CMMI, and as Table 1 reveals, ISY succeeded in reaching this goal at milestone 3 while ASY failed to meet the goal. Below, the implementation process and outcome is further detailed for each of the business units following a short description of each unit.

5.2. Improvement within ASY

ASY is an organization of 143 people and global provider of advanced aerospace technology for fighters, transport aircraft, and helicopters. As such, ASY provides integration of defensive aids and systems to sustain pilots' comprehensive battlefield overview. ASY enjoys long-standing relationships with its military customers, including many of the world's leading airframe manufacturers, systems suppliers, and users. ASY takes pride in being at the technological forefront based on international business relations that secures access to new ground-breaking technological advances.

In December 2005, ASY submitted their implementation plan. According to this plan, nine projects were expected to implement new processes. Initial assessments (milestone 1) showed ASY at 69.3% compliance across the projects. By March 2006 no discernable positive change had occurred; instead, compliance had fallen to 58.3%. By this time, ASY had for strategic reasons decided to accept a fast-track project for an important customer, although it would negatively affect other projects within the business unit. BPIP was one of these projects. By June 2006, ASY had reorganized the implementation plan and the number of participating projects was reduced from nine to two and ASY was on that basis assessed at 67.3% compliance. Despite the increase in process compliance, the business unit had not reached the goal of 75% compliance, and additionally, seven of the original nine projects had failed to produce any substantial results.

5.3. Improvement within ISY

ISY is an organization of 155 people that has evolved through a number of mergers and acquisitions. ISY activities fall into one of four categories: Air Traffic Management, Ground Solutions, Naval Command & Control, and Naval Decoy Systems and the solutions provided are primarily aimed at military customers. ISY enjoys long-standing relationships with many of these customers. The brunt of the technology employed by ISY is software and COTS hardware.

In October 2005, ISY submitted its implementation plan; seven ongoing projects were expected to partly implement the new processes and new projects were expected to fully implement the processes. Initial assessments (milestone 1) showed ISY at 69.0% compliance across the projects. By March 2006, no discernable positive change had occurred; instead, compliance had fallen to 65.6%. By this time, the implementation was, however, progressing as expected with the notable exception of one project. This project attracted management attention, and an effort was successfully made to raise the project to the level of the other projects within ISY. By June 2006, ISY was assessed at 77.2% compliance and it was decided that no additional implementation efforts were needed. The business unit had exceeded the goal of 75% compliance and ISY was declared CMMI level 2 compliant.

6. Subculture Analyses at Terma

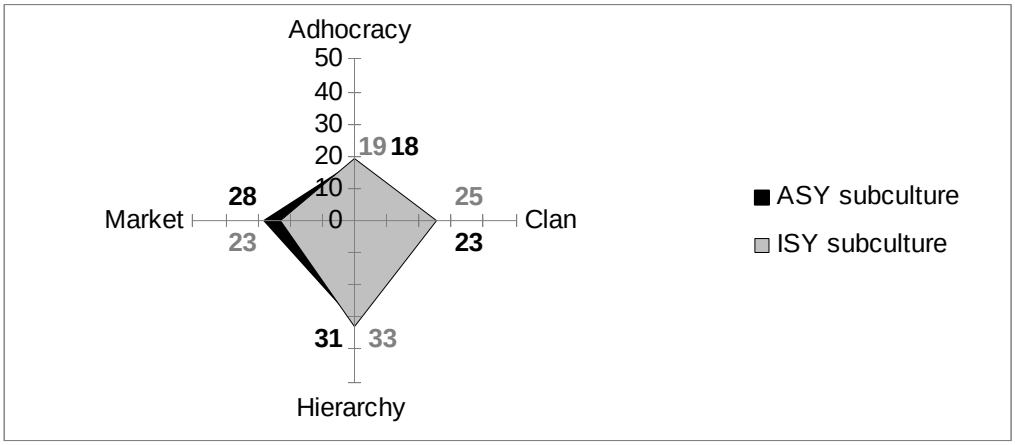
Based on the two different methods for subculture analysis presented earlier, we describe the culture profiles of ASY and ISY in the following.

6.1. Competing Values Analysis

Figure 2 summarizes the culture profiles of ASY and ISY based on the competing values framework (see Figure 1; [11]). The profiles characterize the organizational subcultures relative to four culture types – the clan culture, the adhocracy culture, the market culture, and the hierarchy culture – by depicting their relative strength within each of the business areas. Thus, the ASY culture is 23% clan, 18% adhocracy, 28% market, and 31% hierarchy, whereas the ISY culture is 25% clan, 19% adhocracy, 23% market, and 33% hierarchy.

Figure 2: Organizational Subcultures: Competing Values Profiles

Figure 2. The ASY and ISY subcultures



Four conclusions can be drawn from this analysis. First, a notable balance between the four culture types is evident in both the ASY and the ISY organizational subculture. Second, only small differences exist between the two culture profiles (28% versus 23% market culture in ASY and ISY respectively is the largest detectable variation). Third, the relative balance between the culture types notwithstanding, the hierarchy culture is dominant in both ASY and ISY whereas the adhocracy culture is the weakest of the four types. The cultures in both business units are therefore to a higher degree characterized by stability, efficiency, consistency, predictability, reliability, and uniformity than by creativity, entrepreneurship, innovation, risk taking, and uncertainty. Moreover, emphasis is more on hierarchy, control, and coordination through rule-enforcement and standardization (formal policies, procedures, and rules) than on adaptation, anticipation, experimentation, and flexibility in order to seize new opportunities, i.e. to be a pioneer and to be at the forefront in a rapidly changing world. Fourth, because the culture profiles are almost identical, the competing values analysis does not provide an explanation for the different process implementation outcomes in ASY and ISY. On the contrary, the analysis does not suggest overt conflicts between the values underpinning the CMM models [46] and the cultures in ASY and ISY.

6.2. Clinical Inquiry Analysis

Table 2 summarizes the findings of the clinical inquiry analyses of the cultures in ASY and ISY. The findings in both business units are presented according to the three different levels of organizational culture [58].

Table 2: Organizational Subcultures: Clinical Inquiry Profiles

Levels of Organizational Culture	Business Areas	
	ASY	*ISY*
Artifacts	▪ Informal interaction ▪ Casual attire ▪ 'Tech talk' ▪ Messy offices ▪ Functional environment	▪ Employee diversity ▪ Polite and friendly interaction ▪ Business casual attire ▪ 'Tech talk' ▪ Streamlined offices
Espoused Values	▪ Professional pride ▪ Product quality (quality commitment) ▪ Employee involvement ▪ Stability and dependability ▪ Mutual care	▪ Credible sparring partner ▪ Project commitment ▪ Skill versatility ▪ Stability ▪ Readiness to help and candor
Tacit Assumptions	▪ Equality ▪ Conservatism ▪ Professional challenges	▪ Honesty ▪ Patience ▪ Self-actualization

6.2.1. ASY

At the level of artifacts, the ASY culture was identified by the workshop participants and verified through observation of the office milieu. The dress code was described as "engineer clothes", i.e. casual clothes void of any symbols of authority. The laid back attitude that influenced clothing was

also evident in the way people interacted. Communication within the organization was informal; the organizational hierarchy was not visible; communication was honest and frank, even to the point of conflict; and people were rarely on time for meetings. The term ‘engineer’ that was used to describe the typical clothes of an ASY employee, also adequately describes the lingo or jargon that was audible when speaking to ASY employees. This internal ‘tech talk’ consisted of countless acronyms and technical terms that new employees had to learn in order to cope with daily tasks in the organization. The office environment was emphasizing functionality alone. There were no designer furniture and no frills.

At the level of espoused values, ASY was an organization that signaled a lot of professional pride. “We are a professional, engineering – perhaps somewhat nerdy – organization of people who wish to produce good results.” Their commitment to product quality was closely related to professional pride. This commitment ran deep even to the point where suggesting to relax the standard of quality had become taboo. “The quality of the products that we deliver must of course be high, because the products we create are a matter of life and death in the end, but then you compromise on other things if necessary.” Stability in the sense of dependability is another espoused value, and rules were an important ingredient in ensuring that stability. ASY was described as a “military culture” in which rules created an external image of stability. In turn, this stability supported the professional credibility of the organization. In the same vein, ASY was described as a dependable organization that was responsive to customer needs. “Their [customers’] experience is that they can talk to *Terma*. You cannot talk to other big companies.” Thus, ASY had a reputation of being a trustworthy partner that made good on its promises. “We have a reputation of honoring our agreements. They [the customers] say they only enter into these agreements, because it is *Terma*. Otherwise they would not have made those deals, because it would have been too risky, had it been with another company.” Two other espoused values of a more social nature were employee involvement and mutual care. The employees expected to be consulted when important decisions were made. Hierarchy and top-down style of management were frowned upon. “They [the employees] want an organization that makes everybody feel like they are part of the decision-making process, because if they do not feel like they have a say in the matter, conflicts will arise.” Mutual care, on the other hand, was reflected in the solidarity with colleagues and the consideration for their well-being. Examples of this included concern for the consequences of too heavy a workload and poor working conditions.

At the level of tacit assumptions, equality, conservatism, and professional challenges constituted the core of ASY. Equality was a matter of everybody being treated fairly and as equals. “Both in relation to the floor staff and the senior managers that you run into, there is an openness that allows you to talk and say that you do not agree with them on some subject matter.” Similarly, it was emphasized that “a lot of energy has been spent on taking human needs into consideration.” For its part, conservatism found expression in change resistance. There was an acceptance of the current state of affairs, because it reflected the way things had always been. The following quotation shows the resilience of the status quo: “It has been three months between major organizational changes. We do not pay any heed to it. For us it does not change our work or our goals.” Finally, professional challenges were a cornerstone in the self-image within ASY. Beating the odds and following through on promises were high praised qualities. “We are able to act under pressure and toss aside the rules to deliver as promised, even though it is said that it cannot be done.” In this sense, there was the notion of being innovative, a group of technical entrepreneurs.

6.2.2. ISY

The artifacts identified at the workshop were verified by touring the ISY office building. The diversity among the employees was noticeable. For example, the staff age composition was mixed with both young and old employees, though the average age was high. Also, the professional skills among employees were wide-ranging. In terms of clothing, most people wore casual business attire, and it was discernable who the authority figures were. Examples included a vice president wearing a suit and a senior project manager wearing a tie. The lingo or jargon was technical in nature ('tech talk'), and the interaction among employees was both polite and friendly, e.g. if a newly hired employee asked for help or clarification because of some unfamiliar technical term, he or she received a welcoming and helpful response. The relationship between colleagues was characterized by mutual respect, friendliness, and taking the necessary time to ask and respond to questions. Last, but not least, the ISY office landscape was marked by streamlined offices. The decor was elegant if not exquisite, and it was described as the opposite of a 'coke and pizza milieu'. "Upon entering you will not meet very many of the kind of inexperienced people with their pizza boxes and empty coke bottles that you find elsewhere." Everybody had their own corner which was personalized by pictures and the like which created "a relaxed and cozy atmosphere."

At the level of espoused values, the manifest behavior translated into openness and readiness to help. For example, they gave each other a pat on the back when needed; no question was regarded as stupid or unimportant; and, they did not laugh at one another. Also, stability characterized ISY. It was an inherent property of the organization, but it was also a value that attracted certain types of people. ISY had mainly large, long-running projects with "processes under control" that set the stage for "a long haul" and a "steady pulse beat." Employees were, therefore, not recruited among young and ambitious people of a more restless nature. Typically, employees had other qualities like experience and patience. "Previous experience is required. Quick solutions are not always the way forward here. Employees must, professionally speaking, have sown their wild oats." Besides these attributes, a desirable trait was skill versatility or broad competences. "We are often forced to cover more areas of responsibility than our core competencies permit … Therefore, we must learn to cover more bases." Being an organization that revolved around large projects, people were strongly committed to their projects. The employees' sense of responsibility was closely tied to project goals: "If it is good for the project, it is good for everyday life." Another espoused value related to project commitment was being a credible sparring partner for the customer. Customer satisfaction ensured this credibility, but credibility also required ISY to question the customer's wishes and requests, because "a supplier that always says yes is not trustworthy." Trust in the customer-supplier relationship was built by demonstrating expertise and standards of quality that ISY was not willing to compromise.

At the level of tacit assumptions, honesty, patience, and self-actualization lay at the core of ISY. Honesty was not only an internal feature, but extended beyond the organization to the external realm as well. Internally, Honesty implied a sense of responsibility that forced each and every employee to acknowledge his or her invaluable contribution to the project. "People recognize they have a responsibility to ensure success in the end, no matter what their place in the organizational hierarchy. They want to succeed." Externally, honesty implied responsiveness to customer needs by challenging their proposals and ideas rather than acting as yes-men. Patience was not only a virtue, but also another tacit assumption. Patience was necessary when working on multi-year projects with the reward waiting in the distant future. "The type and length of projects make it difficult to get an immediate reward. It is rare to be able to identify a point in time during the project when something has actually been completed and the result of the work is visible. What we do is often part of a

larger system, and it is difficult at any point in time to spot individual contributions. So in the long run the reward lies in the work itself and in one's own professional pride." Lastly, self-actualization was another tacit assumption shared among employees. According to the employees, the promise of a both demanding and an exciting job that challenges their professional expertise was the reason why people applied for a job in ISY. "If I was not frustrated once in a while, I probably would not be here. It challenges me on an everyday basis." Hence, ISY offered opportunities to progress professionally to the point of becoming what one employee termed the "technological journeyman."

7. Discussion

The goal of this research was to expand our knowledge about the role of culture in SPI implementation. Specifically, we investigated the implications of variations in subculture across software organizations on SPI outcomes as well as practical approaches by which software managers can assess subcultures during SPI initiatives. To that end, we conducted an in-depth, collaborative case study [68], [39] in two business units – ASY and ISY – in a Danish high-tech company.

7.1. Explaining Differences in SPI Outcomes

The two business units followed similar approaches to SPI, but outcomes were quite different. While ISY reached CMMI level 2 as planned, ASY struggled to implement even modest improvements. In an attempt to explain these differences we conducted a competing values analysis [11] and a clinical inquiry analysis [58] of the subcultures in the two business units. The two analyses yielded different results. Whereas the former shows no conspicuous differences between ASY and ISY subcultures that could explain the differences in SPI outcomes, the latter reveals important variations in subcultures between the two units.

Based on the insights from the clinical inquiry analysis, the culture of ASY was incompatible with the means and ends of the SPI project. At the level of artifacts, the casual attire and the messy offices with a focus on functionality was incongruent with the streamlining of processes that the SPI project entailed. A case in point: "Focus in our business unit is on functionality, and it shines through in both our work practices and in our furniture … and the standardization [that is evident elsewhere] has not affected us at all." Thus, the streamlining of processes that the SPI project had occasioned was at odds with the ASY artifacts that emphasized functionality over form. At the level of espoused values, professional pride among the employees clashed with the envisioned changes to existing work practices. The new processes were built on a model (CMMI) that promotes standardization and bureaucratization, and such control mechanisms ran counter to the freedom and personal responsibility that professional pride entailed. The following quotations captures a widespread attitude among ASY employees: "Rules are written for people who cannot cope without guidance," and "I believe that part of what characterizes us is a conflict between professional pride, tradition, and how things are supposed to be done according to rules." At the level of tacit assumptions, the shared belief in equality between employees at all organizational levels presented itself as a barrier to the top-down decision to pursue CMMI based SPI. As the following quotations indicate, the employees in ASY were not ready to blindly accept decisions by upper management: "There is a high degree of openness between employees and managers. It is easy to express your opinion and say 'I do not agree' at any level of the organization. At the same time, once in a while things happen that make people feel like 'where in hell did that come from.' Some decisions are made that do not satisfy the need for involvement." Said another employee: "It is easier for management to push [BPIP] through, if it is evident that there is a rationale behind it, and if it is

apparent that it improves your own and the company's situation." Thus, the management imposed SPI project was at odds with the tacit assumption of equality in ASY.

In contrast, the characteristics of the ISY culture were in good accordance with the means and ends of the SPI project. At the level of artifacts, the polished exterior exemplified by streamlined offices and business casual attire was congruent with the streamlining of processes that the SPI project entailed. Said one employee: "We acquired new furniture and [the building] was nicely decorated when we moved in … so the 'factory' [ISY] has a fairly uniform look." At the level of espoused values, stability was a shared value that supported the envisioned changes to existing work practices. A case in point: "It is a stable workplace … we do not do new things just for the sake of innovation. There has to be a reason for implementing a new technology or method and not just because it's cool or in vogue. In that sense, you might say that, yes, we are conservative." As previously mentioned predictability, reliability, and uniformity were keywords that defined the hierarchy culture underlying the CMMI and thereby the planned process changes. Consequently, control was the common denominator between the ISY culture and the CMMI culture. At the level of tacit assumptions, patience was a virtue that was well aligned with the SPI goals. The employees liked the slow 'pulse' of the organization, and people who thrived in a fast paced environment sought employment elsewhere. Thus, stability was described as an important part of the job, e.g. "it is important to be at rest with oneself." The various coordination mechanisms, i.e. control through procedures and other forms of documentation that is a hallmark of the CMMI, were conducive to a stable working environment in ISY.

Hence, although it is possible to identify cultural features that point in the opposite direction, this analysis shows that the subculture in ISY was well aligned with basic CMMI values while the subculture in ASY was at odds with CMMI values. This insight confirms that it is important for managers to consider the fit between values embedded in new processes and the context in which they are to be implemented as pointed out in the existing literature [16], [17], [67], [20]. At the same time, however, this insight contributes to our knowledge about the relationship between culture and SPI by showing how the three level notion of subculture offered by clinical inquiry analysis, i.e. artifacts, espoused values, and basic underlying assumptions [58], can reveal variations in subcultures that explain differences in SPI outcomes across business units.

7.2. Assessing Subcultures during SPI

In terms of the second research question, the investigation also provides important insights on how managers can inform SPI initiatives through subculture analysis. First, we learned some general lessons across the two types of analysis at *Terma*. The purpose of performing subculture analysis is to determine the degree of alignment between SPI plans and objectives on the one hand, and the existing organizational culture and subcultures on the other hand. To this end both methods may provide decision-makers and change agents with valuable information to help plan an SPI project. Whether such analyses are done at the outset or during an SPI project, they provide cultural sensitivity and can thereby help change agents avoid obstacles and problems. At *Terma*, the clinical inquiry analyses questioned the realism of current expectations and the scale of ambitions in ASY, and in planning the next phase of the SPI project they triggered changes to the original approach. For example, the analysis highlighted the importance of actively involving ASY employees, and with the advantage of hindsight it was a mistake not to ensure this during the initial SPI phase. Due to work pressures and strained resources, ASY management initially decided not to send delegates to the corporate-wide process definition teams tasked with ensuring CMMI compliance. To avoid repetition of this mistake, the next SPI phase had active ASY involvement on all project levels.

Second, we learned that the process of conducting competing values analysis [11] is quite different from that of clinical inquiry analysis [58]. The competing values analysis is a non-intrusive, low cost method whereas the clinical inquiry analysis is a more invasive, cost intensive approach to assessing subcultures. At *Terma*, a typical respondent could fill out the competing values questionnaire in 15 minutes or less, and it required less than an hour to establish a culture profile even if the data were processed manually. The clinical workshops, on the other hand, each required the attendees to set aside half a day or more to participate, and subsequent transcription and analysis required 5 days of work. However, what the competing values analysis offered in terms of speed, it lacked in precision vis-à-vis the clinical inquiry analysis. Thus, there was a trade-off between cost and depth of the two analyses. In addition, keeping the different layers of organizational culture separate during clinical inquiry analysis was non-trivial. For example, it proved difficult to honor the distinction between espoused values and tacit assumptions. Discussions among the participants had a tendency to drift between layers of culture without clear distinctions between layers. Consequently, the clinical inquiry analysis was not only more costly, it also required considerable facilitator skills during the workshops and subsequent analytical capability to make sense of the findings.

Finally, we learned – as discussed above – that the two analyses provide quite different insights into the ASY and ISY subcultures at *Terma*. The competing values analysis [11] revealed no significant subculture variations. Only small differences were found between the ASY and ISY subculture profiles (28% versus 23% market culture in ASY and ISY respectively was the largest detectable variation). This congruence between the subculture profiles implies that the competing values analysis could not explain the different SPI outcomes in ASY and ISY. This is surprising considering previous literature that used the competing values framework to analyze the assumptions underpinning the CMM models [46]. This analysis concluded that the core assumptions of the CMM models are based on "rational rule-governed organization structures that are oriented toward stability, control, and productivity" [46, p. 104]. We would have expected the competing values analysis to depict the subculture within ISY as congruent and the subculture within ASY as incongruent with these assumptions. However, as the two subcultures were shown to be largely identical, we cannot draw such conclusions. Instead, we must question whether the competing values analysis can be used as a practical management tool to bridge cultural insights across SPI practices and models. In contrast, the clinical inquiry analysis [58] revealed several significant variations in subculture between the two business units. On all three culture levels, we found key elements in the ASY subculture that were at odds with CMMI values, whereas the key elements in the ISY subculture were well aligned with CMMI values. Moreover, based on these variations in subculture we were able to explain the differences in SPI outcomes between ASY and ISY. Comparing our experiences using the two frameworks to analyze variations in subculture at *Terma*, it was only the clinical inquiry framework that provided useful insights. This analysis suggested how the initial plans for the company's SPI initiative could have been improved by taking the variations in subculture between ASY and ISY into account. As it turned out, the insights from the analysis were subsequently used to reorganize the SPI initiative within ASY; more employees from ASY were actively involved in the effort; discussions were initiated to explore how new processes could accommodate the sense of freedom and personal responsibility that were key to professional pride within ASY; and, the improvement process was restructured into smaller steps to avoid unnecessary interference with ASY's commitments to its customers. All in all, the experiences from *Terma* therefore suggest clinical inquiry analysis as a promising approach to assess subculture variations and inform decisions about SPI initiatives.

7.3. Implications

As always is the case, this research has a number of limitations. Most importantly, we have presented data from *Terma*, a large Danish high-tech firm and, therefore, the results lean themselves towards SPI initiatives in similar contexts. The role of culture in small software firms might, for example, need different considerations and invite for other approaches than the ones presented here. Also, we adopted two particular lenses on organizational culture (i.e. [11], [58]) and focused on comparing and contrasting those. While these two frameworks are widely known and applied, other cultural lenses might, of course, have provided additional insights and revealed further options for SPI managers.

Based on these limitations and the contributions discussed above, there are two important implications for future research. First, the promising use of clinical inquiry analysis to reveal important variations in subculture as a basis for SPI management raises a number of questions. What are the implications of contemporary SPI models for cultural artifacts, espoused values, and basic underlying assumptions in the adopting organization? Previously, the CMM models have been analyzed using the competing values framework, but there is no similar analysis available based on Schein's clinical inquiry framework [58]. Also, how do artifacts, espoused values, and basic underlying assumptions in different ways shape SPI? What is the relative importance of their impact? And, which forms of intervention could be applied to address cultural issues on each level during SPI? Second, there is a need to expand our understanding of how cultural variations can be addressed during SPI in other forms of organizations, e.g. in small software firms, in IT departments embedded in larger organizations, and in organizations adopting SPI based on other improvement philosophies like Six Sigma [24], Lean [66], and agile development [37].

The research has also important implications for practice. Based on the experiences from *Terma* we suggest the following lessons for managing cultural variations in comprehensive SPI initiatives:

- ***Lesson 1:*** *Consider cultural variations proactively during SPI.* Previous literature has shown that it is important for managers to consider the fit between values embedded in new processes and the context in which they are to be implemented [16], [17], [67], [20]. Our research adds to this picture by showing that variations in subculture have important implications for SPI outcomes. While the subculture analyses at *Terma* were organized after initial process implementation to explain differences in outcomes across ASY and ISY, the insights gained would have been extremely useful as a basis for organizing the effort from the outset.
- ***Lesson 2:*** *Apply clinical inquiry analysis to uncover cultural variations.* Software managers and SPI agents are advised to engage employees to help explicate variations in subcultures guided by clinical inquiry analysis [58]. Separate workshops need to be organized for each involved business unit or for each part of the organization in which subcultures are expected to exist. Van Maanen et al. suggest that frequent interaction, a sense of belonging, and shared problems are key factors in understanding why and where organizational subcultures emerge [64]. Also, it is important to note that subcultures develop over time as subgroup members interact and face new problems together.
- ***Lesson 3:*** *Determine feasibility of adopted approach to SPI.* Once variations in subculture have been uncovered and analyzed, it is important to determine the feasibility of the adopted SPI approach. At *Terma*, the adopted CMMI approach was well aligned with the subculture in ISY while it was incongruent with the subculture in ASY. Because *Terma* operates on the market for military software and systems, and because management found that CMMI could be tailored to different business units, these considerations led to continued commitment to implement CMMI

throughout the organization. The insights from subculture analysis might, in other cases, lead to decisions to adopt a new and different SPI approach that is better suited to the identified organizational culture and subcultures.

- ***Lesson 4:*** *Accommodate cultural variation into SPI approach.* Finally, software managers and SPI agents are advised to reorganize the SPI initiative to better accommodate cultural variation within the organization. At *Terma*, managers used the insights from the subculture analyses to reorganize continued SPI efforts within ASY by actively including employees and ensuring that cultural issues were addressed in the process.

8. Conclusion

In this article we have compared two culture assessment methods – the competing values analysis [11] and clinical inquiry analysis [58] – in terms of their usefulness to assess cultural variations and guide managerial decision-making during SPI. The two methods were deployed to uncover subculture variations between two business units within a Danish high-tech firm, *Terma*, to explain differences in SPI outcomes. Our findings show how subculture variations influence the implementation of new processes and lead to recommendations for how software managers can practically assess subcultures to inform decisions about and help prepare plans for SPI initiatives. The competing values analysis could not explain differences in SPI outcomes between the two business units whereas the clinical inquiry analysis could. The experiences from *Terma* therefore suggest clinical inquiry analysis as a useful and practical approach to guide SPI initiatives. The paper concludes with practical lessons to help managers integrate clinical inquiry analysis into their SPI toolbox.

References

[1] I. Aaen, J. Arent, L. Mathiassen, and O. Ngwenyama, "A Conceptual MAP of Software Process Improvement," *Scandinavian Journal of Information Systems*, vol. 13, pp. 81-101, 2001.

[2] K. Al-Khalifa and E. Aspinwall, "Using the competing values framework to investigate the culture of Qatar industries," *Total Quality Management*, vol. 12, no. 4, pp. 417-428, 2001.

[3] A. Antal, M. Dierkes, and K. Hahner, "Business Perception of Contextual Changes: Sources and Impediments to Organizational Learning," *Business & Society*, vol. 36, no. 4, 387-407, 1997.

[4] N. Ashkanasy, L. Broadfoot, and S. Falkus, "Questionnaire Measures of Organizational Culture," in *Handbook of Organizational Culture and Climate*, N. Ashkanasy, C. Wilderom, and M. Peterson, Eds. California: SAGE Publications, 2000.

[5] S. Barley, "Technology as an Occasion for Structuring: Evidence form Observations of CT Scanners and the Social Order of Radiology Departments," *Administrative Science Quarterly*, vol. 31, no. 1, pp. 78-108, 1986.

[6] M. Beer, "Why Total Quality Management Programs Do Not Persist: The Role of Management Quality and Implications for Leading a TQM Transformation," *Decision Sciences*, vol. 34, no. 4, pp. 623–642, 2003.

[7] P. Berger and T. Luckmann, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*, New York: Anchor, 1966.

[8] B. Boehm, "Unifying Software Engineering and Systems Engineering," *IEEE Computer*, vol. 33, no. 3, pp. 114-116, 2000.

[9] K. Buch and D. Rivers, "TQM: the role of leadership and culture," *Leadership & Organization Development Journal*, vol. 22, no. 8, pp. 365-371, 2001.

[10] A. Cabrera, E. Cabrera, and S. Barajas, "The Key Role of Organizational Culture in a Multi-System View of Technology-Driven Change," *International Journal of Information Management*, vol. 21, no. 3, pp. 245-261, 2001.
[11] K. Cameron and R. Quinn, *Diagnosing and Changing Organizational Culture. Based on The Competing Values Framework*, Massachusetts: Addison-Wesley, 1999.
[12] M. Chrissis, M. Konrad, and S. Shrum, *CMMI : Guidelines for Process Integration and Product Improvement*, Massachusetts: Addison-Wesley, 2003.
[13] A. Dastmalchian, S. Lee, and I. Ng, "The interplay between organizational and national cultures: a comparison of organizational practices in Canada and South Korea using the Competing Values Framework," *International Journal of Human Resource Management*, vol. 11, no. 2, pp. 388-412, 2000.
[14] R. Dayan and S. Evans, "KM your way to CMMI," *Journal of Knowledge Management*, vol. 10, no. 1, pp. 69-80, 2006.
[15] J. Detert, R. Schroeder, and J. Mauriel, "A Framework for Linking Culture and Improvement Initiatives in Organizations," *The Academy of Management Review*, vol. 25, no. 4, pp. 850-863, 2000.
[16] L. Dubé, "Teams in packaged software development: The Software Corp. experience," *Information Technology & People*, vol. 11, no. 1, pp. 36-61, 1998.
[17] L. Dubé and D. Robey, "Software stories: three cultural perspectives on the organizational practices of software development," *Accounting, Management and Information Technologies*, vol. 9, vol. 4, pp. 223-259, 1999.
[18] G. Fine and S. Kleinman, "Rethinking Subculture: An Interactionist Analysis," *American Journal of Sociology*, vol. 85, no. 1, pp. 1-20, 1979.
[19] D. Ford, C. Connelly, and D. Meister, "Information Systems Research and Hofstede's Culture's Consequences: An Uneasy and Incomplete Partnership," *IEEE Transactions on Engineering Management*, vol. 50, no. 1, pp. 8-25, 2003.
[20] H. Frederiksen and J. Rose, "The Social Construction of the Software Operation: Reinforcing Effects in Metrics Programs," *Scandinavian Journal of Information Systems*, vol. 15. no. 1, pp. 23-38, 2003.
[21] R. Galliers, "Choosing appropriate information systems research approaches: A revised taxonomy," in *Information Systems Research: Contemporary Approaches & Emergent Traditions*, H. Nissen, H. Klein, and R. Hirschheim, Eds. The Netherlands: Elsevier, 1991.
[22] B. Hansen, J. Rose, and G. Tjørnehøj, "Prescription, Description, Reflection: The Shape of the Software Process Improvement Field," *International Journal of Information Management*, vol. 24, no. 6, pp. 457-472, 2004.
[23] S. Harrington and T. Guimaraes, "Corporate culture, absorptive capacity and IT success," *Information and Organization*, vol. 15, no. 1, pp. 39–63, 2005.
[24] M. Harry and R. Schroeder, *Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations*, New York: Currency, 1999.
[25] J. Huang, S. Newell, R. Galliers, and S. Pan, "Dangerous Liaisons? Component-Based Development and Organizational Subcultures," *IEEE Transactions on Engineering Management*, vol. 50, no. 1, pp. 89-99, 2003.
[26] J. Jermier, J. Slocum, L. Fry, and J. Gaines, "Organizational Subcultures in a Soft Bureaucracy: Resistance behind the Myth and Facade of an Official Culture," *Organization Science*, vol. 2, no. 2, pp. 170-194, 1991.
[27] G. Johnson and K. Scholes, *Exploring Corporate Strategy*, London: Prentice-Hall, 1997.

[28] A. Kappos and A. Croteau, "Organizational Change and Culture: Insights on BPR projects," *Proceedings of the Eighth Americas Conference on Information Systems*, pp. 2076-2084, 2002.
[29] K. Kautz, "Trends in the Research on Software Process Improvement in Scandinavia," *Scandinavian Journal of Information Systems*, vol. 13, pp. 3-6, 2001.
[30] T. Kekäle, I. Fecikova, and N. Kitaigorodskaia, "To Make It 'Total': Quality Management over Subcultures," *Total Quality Management*, vol. 15, no. 8, pp. 1093-1108, 2004.
[31] A. Kroeber and C. Kluckhohn, *Culture: A Critical Review of Concepts and Definitions*, Massachusetts: Peabody Museum 1952.
[32] M. Krumbholz and N. Maiden, "How Culture Might Impact on the Implementation of Enterprise Resource Planning Packages," in *Advanced Information Systems Engineering: 12th International Conference*, B. Wangler and L. Bergman, Eds. Berlin: Springer, 2000.
[33] J. Kujala and P. Lillrank, "Total Quality Management as a Cultural Phenomenon," *Quality Management Journal*, vol. 11, no. 4, pp. 43-55, 2004.
[34] P. Kuvaja, J. Similä, L. Krzanik, A. Bicego, S. Saukkonen, and G. Koch, *Software Process Assessment & Improvement – The Bootstrap Approach*, Oxford: Blackwell, 1994.
[35] D. Leidner and T. Kayworth, "A Review of Culture in Information Systems Research: Toward a Theory of Information Technology Culture Conflict," *MIS Quarterly*, vol. 30, no. 2, pp. 357-399, 2006.
[36] J. Martin, *Organizational Culture. Mapping the Terrain*, California: SAGE Publications, 2002.
[37] R. Martin, *Agile Software Development: Principles, Patterns, and Practices*, New Jersey: Prentice Hall, 2002.
[38] Mason, J., *Qualitative Researching*, California: SAGE Publications, 2002.
[39] L. Mathiassen, "Collaborative Practice Research," *Information Technology & People*, vol. 15, no. 4, pp. 321-345, 2002.
[40] L. Mathiassen, O. Ngwenyama, and I. Aaen, "Managing Change in Software Process Improvement," *IEEE Software*, vol. 22, no. 6, pp. 84-91, 2005.
[41] L. Mathiassen, J. Pries-Heje, and O. Ngwenyama, *Improving Software Organizations: From Principle to Practice*, Massachusetts: Addison-Wesley, 2002.
[42] S. Maynard-Moody, D. Stull, and J. Mitchell, "Reorganization as Status Drama: Building, Maintaining, and Displacing Dominant Subcultures," *Public Administration Review*, vol. 46, no. 4, pp. 301-310, 1986.
[43] A. Meier, "Occupational Cultures as a Challenge to Technological Innovation," *IEEE Transactions on Engineering Management*, vol. 46, no. 1, pp. 101-114, 1999.
[44] M. Miles and A. Huberman, *Qualitative Data Analysis: An Expanded Sourcebook*, California: SAGE Publications, 1994.
[45] A. Nahm, M. Vonderembse, and X. Koufteros, "The Impact of Organizational Culture on Time-Based Manufacturing and Performance," *Decision Sciences*, vol. 35, no. 4, pp. 579-607, 2004.
[46] O. Ngwenyama and P. Nielsen, "Competing Values in Software Process Improvement: An Assumption Analysis of CMM from an Organizational Culture Perspective," *IEEE Transactions on Engineering Management*, vol. 50, no. 1, pp. 100-112, 2003.
[47] P. Nielsen and J. Nørbjerg, "Software Process Maturity and Organizational Politics," in *Realigning Research and Practice in Information Systems Development: The Social and Organizational Perspective*, B. Fitzgerald and N. Russo, Eds. Boston: Kluwer Academic Press, 2001.

[48] W. Orlikowski, "CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development," *MIS Quarterly*, vol. 17, no. 3, pp. 309-340, 1993.
[49] M. Parker, *Strategic Transformation and Information Technology*, New Jersey: Prentice-Hall, 1995.
[50] M. Paulk, B. Curtis, M. Chrissis, and C. Weber, *Capability Maturity Model for Software (Version 1.1)*, Pittsburgh: Software Engineering Institute, 1993.
[51] A. Pettigrew, "On Studying Organizational Cultures," *Administrative Science Quarterly*, vol. 24, no. 4, pp. 570-581, 1979.
[52] M. Phongpaibul and B. Boehm, "Improving Quality Through Software Process Improvement in Thailand: Initial Analysis," *ACM SIGSOFT Software Engineering Notes*, pp. 1-6, 2005.
[53] I. Png, B. Tan, and K. Wee, "Dimensions of National Culture and Corporate Adoption of IT Infrastructure," *IEEE Transactions on Engineering Management*, vol. 48, no. 1, pp. 36-45, 2001.
[54] R. Quinn and M. McGrath, "The transformation of organizational cultures: A competing values perspective," in *Organizational Culture*, Eds. P. Frost, L. Moore, M. Louis, C. Lundberg, and J. Martin, California: SAGE Publications, 1985.
[55] R. Rapoport, "Three Dilemmas in Action Research," *Human Relations*, vol. 23, no. 6, pp. 499-513, 1970.
[56] M. Rosen, "Breakfast at Spiro's: Dramaturgy and Dominance," *Journal of Management*, vol. 11, no. 2, pp. 31-48, 1985.
[57] T. Rout, "SPICE: A Framework for Software Process Assessment," *Software Process: Improvement and Practice*, vol. 1, no. 1, pp. 57-66, 1995.
[58] E. Schein, *Organizational Culture and Leadership*, California: Jossey-Bass, 2004.
[59] E. Schein, *The Clinical Perspective in Fieldwork*, California: SAGE Publications, 1987.
[60] R. Sims and J. Brinkmann, "Enron Ethics (Or: Culture Matters More than Codes)," *Journal of Business Ethics*, vol. 45, no. 3, pp. 243-256, 2003.
[61] L. Smircich, "Concepts of Culture and Organizational Analysis," *Administrative Science Quarterly*, vol. 28, no. 3, pp. 339-358, 1983.
[62] B. Tan, H. Smith, and M. Keil, "Reporting bad news about software projects: impact of organizational climate and information asymmetry in an individualistic and a collectivistic culture," *IEEE Transactions on Engineering Management*, vol. 50, no. 1, pp. 64-77, 2003.
[63] J. Van Maanen, "The Smile Factory: Work at Disneyland," in *Reframing Organizational Culture*, Eds. P. Frost, L. Moore, M. Louis, C. Lundberg, and J. Martin, California: SAGE Publications, 1991.
[64] J. Van Maanen and S. Barley, "Cultural Organization. Fragments of a Theory," in *Organizational Culture*, Eds. P. Frost, L. Moore, M. Louis, C. Lundberg, and J. Martin, California: SAGE Publications, 1985.
[65] G. Walsham, *Interpreting Information Systems in Organization*, U.K.: Wiley, 1993.
[66] J. Womack, D. Jones, and D. Roos, *The Machine That Changed the World: The Story of Lean Production - Toyota's Secret Weapon in the Global Car Wars That Is Revolutionizing World Industry*, New York: Free Press, 2007.
[67] G. Yamamura, "Process Improvement Satisfies Employees," *IEEE Software*, vol. 16, no. 5, pp. 83-85, 1999.
[68] R. Yin, *Case Study Research Design and Methods*, California: SAGE Publications, 1994.
[69] E. Young, "On the Naming of the Rose: Interests and Multiple Meanings as Elements of Organizational Culture," *Organization Studies*, vol. 10, no. 2, pp. 187-206, 1989.

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